Experimental study of the cross sections of reactions induced by alpha-particles on ^{209}Bi.

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Although the possible therapeutic use of the alpha-emitting radionuclide ^{211}At is put forward since many years, it is only recently that attention regained and that confirmation of earlier obtained information on production possibilities is asked for. In order to check the cross sections of the ^{209}Bi$(\alpha, 2n)^{211}$At reaction and of reactions leading to possible contaminants, two stacks of foils were irradiated at the VUB-Cyclotron with a-beams of 38.5 and 40.5MeV incident energy. The target foils consisted of rather thick (1 to 4 mg/cm^2) metallic Bi evaporated onto pure Cu (10.83micron) or Al (23.92micron) backings. The backings served as recoil catchers and as monitor foils for exact determination of beam parameters and allow an internal consistency check of the energy degradation along the stack. The activities of ^{211}At, ^{211}Po and ^{210}Po were assessed through direct alpha-spectrometry taking advantage of the independent alpha-lines and using a Si-surface barrier detector at different times after EOB. The important energy degradation in the targets of the emitted alpha-rays resulted in broadened peaks often showing the effects of thermal diffusion towards the surface of the targets of the radionuclides formed in the Bi-bulk. The efficiency calibration of the set-up was performed for different sample-detector distances using a ^{228}Th source. The activity of ^{210}At was measured by direct gamma-spectrometry shortly after EOB. The measured cross sections for ^{211}At, ^{210}At, ^{211}Po and ^{210}Po are in good agreement with the earlier published results of Ramler et al. [1] and of Lambrecht and Mirzadeh [2]. The small contribution of the ^{209}Bi$(\alpha, t)^{210}$Po reaction to the direct production of ^{210}Po, apart from the decay of parent ^{210}At, could be confirmed. Theoretical thick target yields and optimised irradiation parameters (incident energy and target thickness), in function of acceptable ^{210}At–^{210}Po contamination levels and time of use, will be presented.

[1] W.J. Ramler, J. Wing, D.J. Henderson and J.R. Huizenga, Physical Review, 114, 1958, p 154.
[2] R.M. Lambrecht and S. Mirzadeh, Int. J. Applied Radiation and Isotopes, 36, 1985, p 443.

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